2021 WINTER WEATHER EVENT OPERATIONS REPORT

Disclaimer: The SPP board of directors approved the Comprehensive Review of SPP's Response to the February 2021 Winter Storm report and its high-level recommendations in July 2021. The Regional State Committee created the Improved Reliability Task Force (IRATF) to take primary responsibility for addressing Tier 1 recommendations related to fuel assurance and resource planning and availability. SPP staff is tracking implementation of all recommendations as they move through the stakeholder process.

This report contains the Operations Path initiatives as they were originally written. Initiatives may be updated. Updates to those initiatives can be found in the IRATF Winter Weather Event Initiative Report and in their respective Stakeholder Initiative Report folders.

By Chris Haley, Zachary Sharp, Adam Bell, Erin Cathey

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Version 1

REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION	COMMENTS
Draft	SPP and Working Group SMEs	Initial draft	
02/06/2022	Erin Cathey	Updating with SIR numbers to post for reference in roadmap prioritization	

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EXECUTIVE SUMMARY

Immediately after the winter storm, SPP staff began analyzing the event. Staff prepared a draft report and shared it with members of the Market Working Group (MWG), Operating Reliability Working Group (ORWG), Supply Adequacy Working Group (SAWG) and Transmission Working Group (TWG). The report included information pertaining to operational activities and observations before and during the events.

The working groups met multiple times to review the draft event report and develop recommendations. The SAWG held six executive sessions to discuss the event and reviewed the recommendations at three regular meetings. The ORWG held 13 executive sessions dedicated to the event and discussed it at one regular meeting. The TWG held four executive sessions to discuss the event and reviewed recommendations at two regular meetings. The MWG held seven executive sessions dedicated to the event and discussed it at three regular meetings. The four groups held a joint executive session where all members could come together to collaborate

Each section of this operations path report includes the high-level recommendations contained in the Comprehensive Review of SPP's Response to the February 2021 Winter Storm report. This report and its high-level recommendations were approved by the SPP board of directors in July 2021. This operations path report also provides sub-listings of initiatives that help address the recommendations. The initiatives included were developed through the stakeholder review process described above, have been mapped to the approved high-level recommendations, and may be modified as further assessment and development continue. While implementation of these recommendations does not ensure SPP will avoid emergency situations in the future, the recommendations will reduce risk of reoccurrence and improve SPP's preparedness for future events.

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COMPREHENSIVE REVIEW PROCESS

SPP's comprehensive review of the February 2021 winter weather event included input from SPP staff and representatives of stakeholder groups including members, market participants, SPP's independent market monitor, regulators, elected officials and members of the media, among others. A steering committee was formed to ensure coordination and communication among parallel efforts conducted by the five teams identified below. Members of the steering committee were:

Lanny Nickell, Chair (SPP chief operating officer)

Larry Altenbaumer (Chair of the SPP Board of Directors)

Barbara Sugg (SPP president and chief executive officer)

Betsy Beck: Finance review co-lead (Members Committee representative, Enel Green Power North America director, organized markets)

Denise Buffington: Operations review lead (Evergy director of regulatory affairs)

Keith Collins: Market monitoring review lead (Executive director of SPP Market Monitoring Unit)

Tom Dunn: Finance review lead (SPP chief financial officer)

Kristie Fiegen: Regional State Committee review lead (South Dakota Public Utilities commissioner)

Joe Lang: Operations review co-lead (Members Committee representative, OPPD director of energy regulatory affairs)

Mike Ross: Communications review lead (SPP senior vice president of government affairs and public relations)

Reporting to the steering committee were five teams tasked with performing their own evaluations of various aspects of the February winter weather event's impacts. Each team's roster and scope are identified below along with notes regarding their evaluation process and/or outcomes.

OPERATIONS REVIEW

Four of SPP's working groups reviewed the event to develop recommendations: the Market Working Group (MWG), Operating Reliability Working Group (ORWG), Supply Adequacy Working Group (SAWG) and Transmission Working Group (TWG).

Operations Review Leads

Denise Buffington, chair
Evergy, SPP MOPC chair

Joe Lang
Omaha Public Power District

Market Working Group

Richard Ross, MWG chair
American Electric Power-Southwestern Electric Power

Jim Flucke, MWG vice chair
Evergy Companies

Erin Cathey, MWG staff secretary
SPP

Aaron Rome
Midwest Energy

Betsy Beck
Enel Green Power North America

Carrie Dixon
Xcel Energy

Chandler Brown
Sunflower Electric Power Corporation

Eric Alexander
Grand River Dam Authority

Jack Clark
NextEra Energy Resources

Jack Madden
East Texas Electric Cooperatives

John Varnell
Tenaska Power Services

Lee Anderson
Lincoln Electric System

Michael Massery
Arkansas Electric Cooperative Corporation

Neal Daney
Kansas Municipal Energy Agency

Rick Yanovich
Omaha Public Power District

Shawn Geil
Kansas Electric Power Cooperative

Shawn McBroom
Oklahoma Gas and Electric

Valerie Weigel
Basin Electric Power Cooperative

Yohan Sutjandra

City Utilities of Springfield

Operating Reliability Working Group

Allen Klassen, ORWG chair
Evergy Companies

Ron Gunderson, ORWG vice chair
Nebraska Public Power District

Zachary Sharp, ORWG staff secretary
SPP

Abubaker Elteriefi
ITC

Allan George
Sunflower Electric Power

Bryn Wilson
Oklahoma Gas & Electric

Chance Myers
Western Farmers Electric Cooperative

Chris Shaffer
American Electric Power

David Pham
The Empire District

Doug Peterchuck
Omaha Public Power District

Gary Plummer
Independence Power & Light

Jeff Wells
Grand River Dam Authority

Jim Useldinger
GridLiance High Plains

John Roemen
Western Area Power Administration

Keith Carman
Tri-State Generation and Transmission Association

Kyle McMenamin
Southwestern Public Service Company /Xcel Energy

Laurie Gregg
Lincoln Electric System

Mark Eastwood
City Utilities of Springfield

Matt Pawlowski
NextEra Energy Resources

Supply Adequacy Working Group

Natasha Henderson, SAWG chair
Golden Spread Electric Cooperative

Tom Hestermann, SAWG vice chair
Sunflower Electric Power Corporation

Chris Haley, SAWG staff secretary
SPP

Aaron Castleberry
Oklahoma Gas & Electric

Aaron Ramsdell
Basin Electric Power Cooperative

Adam Graff
Heartland Consumers Power District

Amy Newton
City Utilities of Springfield

Bennie Weeks
Xcel Energy Services

Brian Berkstresser
Liberty Utilities

Colton Kennedy
Omaha Public Power District

David Sonntag
Western Farmers Electric Cooperative

Eric Alexander
Grand River Dam Authority

Ernesto Perez
East Texas Electric Cooperative & Northeast Texas Electric Cooperative

Jeffrey Plew
NextEra Energy Resources

Jim Jacoby
American Electric Power-Public Service Co of OK

Jodi Knutson
WAPA

John Varnell
Tenaska Power Services

Robert Janssen
Dogwood Energy

Thomas Saitta
Kansas Municipal Energy Agency

Timothy Cerveny
Nebraska Municipal Power Pool

Traci Bender
Nebraska Public Power District

Walt Cecil, CAWG liaison Missouri Public Service Commission

Transmission Working Group

Derek Brown, TWG Chair
Evergy Companies

Joshua Verzal, TWG Vice chair
Omaha Public Power District

Adam Bell, TWG staff secretary
Southwest Power Pool

Andrew Berg
Missouri River Energy Services

Arash Ghodsian
EDF Renewables Development

Chris Pink
Tri-State Generation and Transmission Association, Inc.

Clifford Franklin
Sunflower Energy

Gayle Nansel
Western Area Power Administration

James Ging
Kansas Power Pool

Jarred Cooley
Xcel Energy

Jason Shook
East Texas Electric Cooperative

Jim McAvoy
Oklahoma Municipal Power Authority

Joe Fultz
Grand River Dam Authority

John Boshears
City Utilities of Springfield, Missouri

John Knofczynski
East River Electric Power Cooperative

Kalun Kelley
Western Farmers Electric Cooperative

Matthew McGee
American Electric Power

Michael Mueller
Arkansas Electric Cooperative Corporation

Michael Wegner
ITC Holdings

Nate Morris
Liberty Utilities

Nathan McNeil
Midwest Energy

Noman Williams
GridLiance High Plains

Phil Westby
Basin Electric Power Cooperative

Randy Lindstrom
Nebraska Public Power District

Scott Benson
Lincoln Electric System

Shane McMinn
Golden Spread Electric Cooperative

Steve Hardebeck
Oklahoma Gas & Electric

KEY OBSERVATIONS

The comprehensive review yielded seven key observations regarding the root causes of the winter storm's impact, SPP's response and its preparedness to respond to future reliability events.

1. The unavailability of generation, driven mostly by lack of fuel, was the largest contributing factor to the severity of the winter weather event's impacts, which was exacerbated by record wintertime energy consumption and a rapid reduction of energy imports.

   This root cause drives the need to develop policies that improve fuel assurance and resource adequacy and highlights the need to further assess SPP's ability to reliably operate the system with more intermittent and fewer base-load resources. Better coordination and communication between the gas and electric industries could have significantly improved preparation activities.

2. Extremely high natural gas prices were the primary driver of record-high energy offers that exceeded the FERC-required offer cap of $1,000/megawatt-hour (MWh) for the first time in SPP's market history. On Feb. 15, SPP's market price reached an all-time high of $4,274.96/MWh in the day-ahead market. By comparison, the average price of energy in SPP's day-ahead market for the entire year of 2020 was $17.69/MWh. Natural gas markets are not subject to price or offer caps, while electricity markets like SPP's are.

3. The rapid spike in SPP's market prices resulted in an immediate concern about liquidity of market participants and created an exponential increase in short-term credit exposure.

4. Relationships and interconnections with neighboring systems were critical. Usually a net exporter of energy, SPP relied significantly on imported energy to serve load during the winter event, with net amounts exceeding 6,000 megawatts (MW) at times. This emphasizes the value these relationships and robust transmission interconnections provide during emergency events and the opportunity to further strengthen them.

5. The SPP transmission system was highly congested at times during the event with limitations that prevented full use of generation available in certain locations.[6] This issue exacerbated SPP's need to achieve balance between regional supply and demand through use of its load-shed procedures and raised questions about the appropriateness of regionally allocating load-shed responsibilities.

6. Early preparation, timely decisions and effective communication helped minimize the winter storm's impact on reliability. Early communication of a public appeal for conservation contributed to reduced demand Feb. 15, reducing the amount of controlled service interruptions required. Effective communication of and prompt response to load- shed instructions likewise mitigated the risk of uncontrolled blackouts.

7. SPP's stakeholders indicated general satisfaction with SPP's emergency communications, information sharing and credibility related to the winter storm response, although some areas of improvement were identified, particularly in those related to end-use customer awareness.

More on these key observations and related issues can be found in the Comprehensive Review of SPP's Response to the February 2021 Winter Storm.

OPERATIONS PATH RECOMMENDATIONS

Throughout the comprehensive review, SPP staff and stakeholders evaluated hundreds of potential process changes, system enhancements, new and amended policies, further assessments, and other potential solutions meant either to address the root causes of the February 2021 event's impact on the SPP system or to better enable SPP and its stakeholders to respond to future extreme system events. This report recommends actions, policy changes and assessments categorized in three tiers according to urgency, importance, impact and other factors. Full implementation of many of these recommendations will be subject to further approvals as prescribed by SPP bylaws.

Recommendations are categorized according to a three-tier ranking system defined as follows:

- **Tier 1:** Recommended actions, policies or assessments deemed necessary and urgent to avoid severe reliability, financial, operational, compliance or reputational risks.

  These recommendations are expected to address system-related root causes of the 2021 winter event or mitigate occurrence of future extreme system event impacts.

  Upon board approval, work associated with implementation of these recommendations shall be prioritized by the organization at the highest level and begin immediately.

- **Tier 2:** Recommended actions, policies or assessments deemed necessary to minimize the risk of severe reliability, financial, operational, compliance or reputational consequences associated with extreme system events.

  These recommendations may not address system-related root causes of the 2021 winter event or mitigate occurrence of future extreme system event impacts, but are important, are expected to significantly improve SPP's response to extreme system events in the future, and shall be treated as high-priority initiatives.

- **Tier 3:** Recommended actions, policies or assessments that would improve SPP's response, communications and public perception during extreme system events, but are not urgent.

Recommendations are also categorized into one of three possible types, defined as follows:

- **Action**: Development and/or implementation of a new process, requirement, protocol or other activity.

- **Policy**: Development of principles to be used to guide subsequent development of requirements, protocols, and/or processes using the stakeholder process in accordance with bylaws, tariff provisions and applicable regulations.

- **Assessment**: Performance of analysis that informs development of solutions through the stakeholder process.

FA. ENHANCE FUEL ASSURANCE

FUEL ASSURANCE

Table 2: Summary of recommendations to the board related to fuel assurance

#	TIER	CATEGORY	RECOMMENDATION
FA 1	1	Policy	Develop policies that enhance fuel assurance to improve the availability and reliability of generation in the SPP region.
FA 2	1	Assessment	Evaluate and, as applicable, advocate for improvements in gas industry policies, including use of gas price cap mechanisms, needed to assure gas supply is readily and affordably available during extreme events.
FA 3	2	Policy	Develop policies to improve gas-electric coordination that better inform and enable improved emergency response.

OVERVIEW OF GENERATING CAPACITY

Generation resources within the SPP region provide generating capacity through a diverse range of fuel types. This diversity is comprised primarily from coal and natural gas resources that provide a dispatchable capacity largely independent of meteorological conditions with wind resources providing a comparable amount of variable capacity.

During the 2021 winter weather event, all resource types experienced challenges ranging from operational reductions to total resource outages resultant from either frozen equipment or interrupted fuel supplies.

NATURAL GAS RESOURCES

The generating resources most impacted by the 2021 winter weather event were those fueled by natural gas. Similar to electric power, the available natural gas fuel for consumption by electric generation and other customers is limited by the capacity of the supplies and transportation provided by the gas pipeline system. Extreme cold weather experienced across the SPP region resulted in natural gas procurement and deliverability issues. Increased demand for natural gas to heat homes combined with production issues attributed to wellhead freeze-offs resulted in a lack of access to natural gas by generator operators.

It is important to note that the electric industry does not have the ability, nor should it have the responsibility, to ensure a reliable and resilient natural gas supply. It is incumbent upon the

natural gas industry to make the changes necessary to improve the supply of natural gas during extreme weather events. It is imperative that regulators understand the limitations of the electric industry in improving natural gas supply. Any new requirements to improve natural gas supply need to be imposed upon the gas industry and not the electric industry if this situation is to be improved.

GAS-ELECTRIC COORDINATION AND COMMUNICATION

The lack of access to natural gas was the largest contributing factor to the severity of the event, and establishes the need for better coordination and communication between the gas and electric industries moving forward. In particular, additional early communication of potential severe conditions and the forecasted high demand for natural gas could have provided both industries with useful preparation time.

SPP has made several improvements related to gas-electric coordination in the last five years. In 2015, FERC issued Order No. 809 "Coordination of the Scheduling Processes of Interstate Natural Gas Pipelines and Public Utilities." In response to the order, in October 2016 SPP shortened the Day-Ahead Market (DAMKT) timeline by 30 minutes and shifted the closing and posting times earlier in the day. In May 2020, SPP further reduced the DAMKT timeline by an hour. In addition, between 2016 and 2018, SPP coordinated with Market Participants to increase awareness of the need for additional detail in outage reporting, particularly fuel issues. SPP also recently implemented a multi-day commitment and pricing forecast which should provide generation owing Market Participants with additional information related to generation needs. SPP continues to seek opportunities for gaining efficiencies which better align the DAMKT with the gas day.

While SPP has focused on communication between the Regional Transmission Organization (RTO) and the Market Participant, SPP believes there should be a focus on increased communication between the RTO and the gas industry, i.e., communicating the need for gas and any deliverability issues of gas. SPP also believes it is important to understand the impacts of the development of natural gas fueled resources on the gas industry, and feels it is imperative to coordinate new projects with the gas industry, with the goal being to either increase the RTO knowledge of gas resource availability or increase the availability of gas to those same resources.

Certain system conditions may result in severe impacts to the electric or gas infrastructure. Better coordination is needed between the electric and gas industries to identify potential infrastructure contingencies within the SPP RTO that could have a large impact on gas generators within the SPP region. The SPP Balancing Authority (BA) Emergency Operating Plan (EOP) does not presently include procedures for assessing and analyzing gas infrastructure reliability impacts on the SPP region during severe weather events, capacity emergency procedures, significant pipeline maintenance outages, pipeline operational flow orders, or during any other applicable conservative operations event.

FUEL SUPPLY CRITICAL LOADS

During the load shed events, there were concerns from Transmission Operators (TOPs) that natural gas compressor station loads may be curtailed, exacerbating the fuel shortage issue, and causing a need for additional load shed. There are additional concerns that these critical loads do not have adequate backup plans to continue operating in the event of a loss of interconnection to the grid such as gas fired compression. Reliance upon the electric grid to power compressors will lead to interruptions in service due to other forced outages not initiated by the TOP.

FUEL SUPPLY

The 2021 winter weather event highlighted the weaknesses of the components of the supply-side of the grid. All forms of generation were stressed and there were outages across all generation types. The event struck during a time of change in the way energy and capacity are supplied in the region. The event highlighted the need to further assess SPP's ability to reliably operate the system with the increased use of intermittent resources and further reduction of base load resources. Over the last two years, SPP has been assessing the way this supply is accredited. Part of the reason for this is that as the resource mix changes and the SPP region has grown, the way resource adequacy has been determined in the past does not appear adequate to meet the needs of the future. There are other reasons as well. Summer peak assessments cannot accurately determine the needs of a severe event in the winter. Fuel supplies are under different constraints, wind and solar patterns are different, and the ability of a generator to start can vary markedly. Because of this, SPP needs to have a better understanding of the strengths and weaknesses of all resource types during times other than summer. SPP should also assess the importance of diversity in supply and demand resources and how these resource types interact with each other during periods of stress and assess cost effective ways to ensure that reliability is able to be maintained. The 2021 winter weather event underlined the importance of this work.

Currently, SPP has fuel supply requirements in section 7.1.5 of the SPP Planning Criteria. The language states "*Assurance of having desired generating capacity depends, in part, on the availability of an adequate and reliable fuel supply. Where contractual or physical arrangements permit curtailment or interruption of the normal fuel supply, sufficient quantities of standby fuel shall be provided. Due to the dependence of hydroelectric plants on seasonal water flows, this factor shall be taken into consideration when calculating capacity for reserve margin requirements.*"

FA RECOMMENDATIONS

FA1.DEVELOP POLICIES THAT ENHANCE FUEL ASSURANCE TO IMPROVE THE AVAILABILITY AND RELIABILITY OF GENERATION IN THE SPP REGION. (TIER 1, POLICY)

- *SIR206. FA1.1.* Assess root causes and impacts of fuel supply issues, i.e., gas

transportation, production, or cost and develop appropriate solutions.

- *SIR207 FA1.2.* Evaluate fuel supply limitations in the seasonal Loss of Load Expectation (LOLE) studies.

- *SIR208 FA1.3.* Evaluate if resources can be considered firm if the primary fuel has an availability risk or if the at-risk fuel resource should have dual fuel capability.

- *SIR209 FA1.4.* Evaluate whether or not resources can be considered firm if the primary fuel has an availability risk or if the at risk fuel resource should have dual fuel capability.

FA2.EVALUATE AND ADVOCATE AS APPLICABLE FOR IMPROVEMENTS IN GAS INDUSTRY POLICY NEEDED TO ASSURE GAS SUPPLY IS READILY AVAILABLE DURING EXTREME EVENTS, INCLUDING CONSIDERING A POTENTIAL GAS PRICE CAP. (TIER 1, ASSESSMENT)

- *SIR211 FA2.1.* Evaluate effectiveness of a multi-day market to understand and mitigate the disconnect between market outcomes and the need to procure fuel several days in advance, e.g., over the weekend. (Moved to Tier 2)

- *SIR212 FA2.2.* Where cost was a root cause of gas supply issues, assess how SPP should advocate for an emergency gas cap for high prices when buying gas in emergency or EEA level events is appropriate.

- *SIR213 FA2.3.* Discuss potential role of the RTO in gas-electric coordination. The RTO should take an active role on behalf of the entire market to advocate for change in the gas industry.

    - SPP needs to clearly communicate to regulators that the electric industry cannot improve the availability of natural gas during extreme events. Requirements need to be imposed upon the gas industry if this situation is to be improved.

    - RTO should consider advocating for additional oversight and communication on gas prices in emergency events.

    - SPP needs to clearly communicate with regulators and the natural gas industry the importance of real-time and near real-time communications between the RTOs and on pipeline and supply operational needs and any limitations in support of these needs.

    - SPP should consider asking FERC to address the operational conflicts that exist between two FERC approved tariffs during emergencies like the 2021 winter weather event. Conflicts that exist when SPP, under its FERC approved Tariff, directs a generating unit to operate in a manner that conflicts with a gas pipeline owner that is assessing operational flow warnings and penalties, under their FERC approved tariffs.

- *SIR214 FA2.4.* Inform gas pipeline operators they are susceptible to power outages caused by other events not controlled by the TOPs & encouraged to be prepared for such losses of service.

FA3.DEVELOP POLICIES TO IMPROVE GAS-ELECTRIC COORDINATION THAT WILL BETTER INFORM AND ENABLE IMPROVED EMERGENCY RESPONSE. (TIER 2, POLICY)

- *SIR216 FA3.1.* Establish improved and more direct communication between SPP and the gas pipeline industry, particularly during emergency conditions such as those encountered during the 2021 winter weather event, to:
    - Increase SPP's knowledge of gas pipeline outages and deliverability issues.
    - Increase SPP's knowledge of unique Market Participant gas delivery situations, such as pre-existing gas storage, resource location and impact of gas pipeline status, and lack of gas creating additional complications, e.g., loss of human needs or critical loads.
    - Mitigate the risk of load shed events having a negative effect on gas deliverability or usability.
- *SIR217 FA3.2.* Coordinate with the gas industry to assess and define a set of contingencies which simulate potential gas infrastructure failures or limitations on SPP gas generators based on their pipeline connectivity. Modify the SPP BA EOP to incorporate procedures for using SPP gas pipeline contingencies within uncertainty studies, day-ahead studies and/or real-time studies, as necessary, when electric system emergencies and gas pipeline limitations may coincide. Procedures should include coordination in real-time to assess and refine the gas infrastructure contingency list to mimic present day emergency conditions. The contingency list should be reviewed annually as part of the SPP BA EOP review and saved in a Critical Energy/Electric Infrastructure Information (CEII) location.
- ~~DELETED: FA3.3. SPP working groups should develop policies to improve gas-electric coordination that will better inform and enable improved emergency response.~~
    - ~~Operating reliability issues: ORWG.~~
    - ~~Fuel adequacy for accredited capacity: SAWG.~~
    - ~~Further progress on gas-electric timeline alignment: MWG.~~
- SIR 218 FA3.4. Generation Operators (GOPs) should coordinate with gas pipeline operators to identify fuel supply critical loads, and work with TOPs to exclude those loads in load shed plans.

RPA. IMPROVE RESOURCE PLANNING AND AVAILABILITY

RESOURCE PLANNING AND AVAILABILITY

Table 3: Summary of recommendations to the board related to resource planning and availability

#	TIER	CATEGORY	RECOMMENDATION
RPA 1	1	Assessment	Perform initial and ongoing assessments of minimum reliability attributes needed from SPP's resource mix.
RPA 2	1	Policy	Improve or develop policies, which may include required performance of seasonal resource adequacy assessments, development of accreditation criteria, incorporation of minimum reliability attribute requirements, and utilization of market-based incentives that ensure sufficient resources will be available during normal and extreme conditions.

ACCREDITATION

Historically, data has shown that the average economic max capacity for conventional resources in SPP's Integrated Marketplace is lower than the accredited capacity submitted for resource adequacy. SPP and the SAWG have diligently worked over the last two years to begin implementing more robust and reliable accreditation methodologies across all resource types. This effort started with the implementation of the effective load carrying capability (ELCC) methodology for wind, solar and battery storage starting with the 2023 summer season. Additionally, there is an effort underway to evaluate a form of performance-based accreditation for conventional resources.

WINTER SEASON LOLE STUDY

LOAD COMPARISON REVIEW

The projected non-coincident peak load forecasted leading into the 2020/2021 winter season was approximately 43,700 MW, which was submitted by the load responsible entities. This load forecast is based on a 50/50 probability of occurring. During the 2021 winter weather event, the SPP BA experienced a coincident peak demand of 43,661 MW. During this event, SPP forecasted peak load as high as 47,000 MW. Supply would have been adequate at either of these peak loads at normal historical generation outage levels.

GENERATION AVAILABILITY REVIEW

Based on capacity that was submitted by members for the resource adequacy winter season obligation, the projected peak generation available for 2020/2021 winter was roughly 65 GW. During the week of February 14, 2021 the available generation in the SPP went as low as 35 GW (Figure 1), which was roughly 20 GW lower than the five-year historical average of available generation during the month of February, 2021. The record cold temperatures across the entire SPP region resulted in a significantly higher generation fleet outage rate than normal.

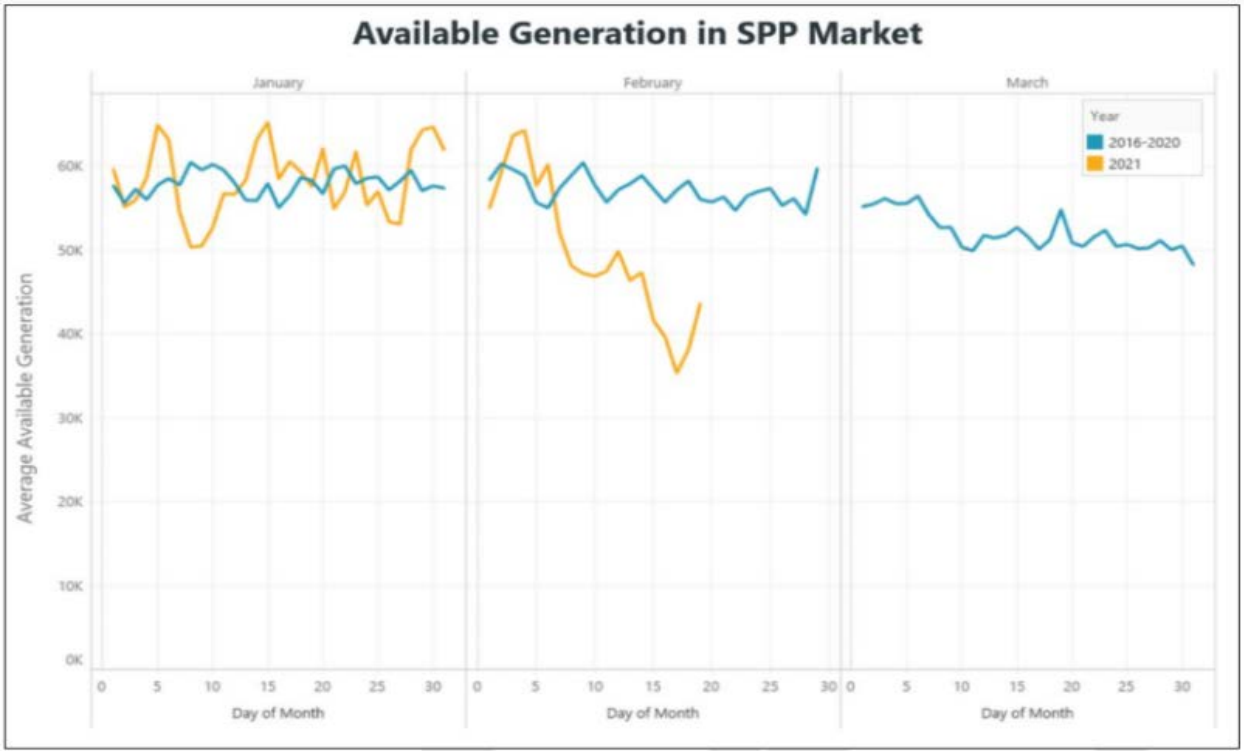

Figure 1 Available Generation

LOLE STUDY

Currently, SPP resource adequacy policies place an obligation on each load responsible entity (LRE) to meet their individual winter season non-coincident demand plus the planning reserve margin (PRM) requirement. The winter season PRM is based on the LOLE study that is performed every two years and determines the appropriate amount of capacity needed to reliably maintain the 1 day in 10-year standard. While this study encompasses the whole year, its focus is on the summer peak season, for which the majority of loss of load in the SPP region is analyzed to occur during the summer timeframe. Therefore, the PRM applied to the winter season is based on the summer season demand values. Expectations of abnormally excessive generation outages during extreme weather events (cold, heat, drought, flooding, atmospheric conditions) are not currently included in the planning study with a higher than previously experienced occurrence rate.

OUTAGES

During this event, there were approximately 4,000 MW of generation on planned outage that were rescheduled. Prior to 2021, SPP has allowed a certain amount of planned outages during the winter season averaging around 6,000 MW. Maintenance and forced outages are included in the LOLE study in the winter and shoulder seasons, but planned outages are not scheduled in the summer season.

Currently, LREs that schedule planned outages during the summer season are not allowed to count that capacity toward their resource adequacy requirement. As risk of loss of load is seen to expand beyond the summer season into the winter season and potentially into the shoulder months, additional policy may need to be addressed on how accredited capacity may be counted in the summer and winter seasons with planned outages taken into account.

WINTER PREPAREDNESS

SPP does not validate the winter preparedness policies and procedures for generation in the SPP BA, but in the past has conducted member surveys on winter weather preparedness. As part of the event review, SPP and the SAWG reviewed forced outage data, for outages beginning on February 7, 2021 when extreme weather and temperature conditions began moving into the central and southern regions of SPP. This review found a reduction in generation availability due to the extreme weather, which was magnified by the record cold temperatures. Throughout the event, forced outages were continually submitted into SPP's outage application. By the end of the day on February 16, 2021 there were over 19 GW of forced outage and de-rates on the system.

ENERGY DELIVERY

The 2021 winter weather event made it clear that adequate transmission to deliver power is critically important in decreasing the impact from future extreme conditions. Transmission, both within and outside SPP, proved critical in avoiding longer outages and pointed to the importance of appropriately assessing the deliverability of a dispersed set of resources across the eastern interconnection during such times. This includes transmission on the SPP/MISO seam that significantly helped with the imports of energy from MISO and PJM. The event also highlighted the point that we need to refocus our efforts in the study process to evaluate the necessary transmission to ensure adequate transmission capacity. Other forms of energy and our increased focus on improving the transmission system are critical to decrease the possibility of further intentional disruption of power to customers. The 2021 winter weather event is a credible scenario that we need to adequately scrutinize in order to understand potential impact of such events and protect against as we plan for the future (inability to meet demand with resource and/or fuel unavailability).

MUNICIPAL GENERATION, DEMAND RESPONSE AND BEHIND-THE-METER AVAILABILITY

There were municipal generators not directly connected to the SPP transmission system that were capable of operating but did not run during the event. SPP, as the BA, does not have a complete picture of all resources that may be available to assist during an energy emergency and as a result some resources did not assist where needed. SPP did issue appeals to members to identify any resources not in the market that could assist with supplying load, but some were still not notified to come on-line.

RPA RECOMMENDATIONS

RPA1. PERFORM INITIAL AND ONGOING ASSESSMENTS OF MINIMUM RELIABILITY ATTRIBUTES

- *SIR219.1 RPA1.1.* Reliability Attributes Needs Assessment (Current Day) - Quantify how much of the 10 reliability attributes we need today. Define conditions such as duration of providing attribute.
- *SIR219.2 RPA1.2.* Reliability Attributes Needs Assessment (Future) - Quantify how much of the 10 reliability attributes we need in future as SPP BA resource mix and SPP BA load profiles change.
- *SIR219.3 RPA1.3.* Resource Capability Assessment - Determine the capability of all SPP BA resources to provide the 10 reliability attributes. Determine the capability of future resource types.
- *SIR219.4 RPA1.4.* Scenario Development - Develop realistic scenarios for future years (3-5-10 years out) that specify/forecast the available resource type mix of the SPP BA fleet in those future horizons and specify what SPP BA load profiles could look like.
- *SIR219.5 RPA1.5.* Reliability Assessment of Future Scenarios - Assess for all identified future scenarios if we will have enough of each required attribute to reliably operate the SPP BA.
- *SIR219.6 RPA1.6.* Develop Process to Perform Recurring Assessments - Develop a framework for performing an annual or biennial assessment of adequacy of the reliability attributes of the SPP BA fleet for the near future.
- *SIR219.7 RPA1.7.* Develop Policies to Secure Needed Attributes - Develop policies and recommendations for incorporation of minimum reliability attributes in Resource Adequacy assessments.

RPA2. IMPROVE OR DEVELOP RESOURCE ADEQUACY POLICIES, WHICH MAY INCLUDE PERFORMANCE OF SEASONAL ASSESSMENTS THAT ENSURE SUFFICIENT RESOURCES ARE AVAILABLE DURING NORMAL AND EXTREME CONDITIONS. (TIER 1)

- *SIR221 RPA2.1.* Identify the appropriate accreditation of all resources.
- *SIR 222 RPA2.2.* Expand accreditation efforts that are currently underway to evaluate performance-based accreditation for conventional resources to the winter season and severe conditions across each season.
- *SIR223 RPA2.3.* Perform an annual evaluation of the availability of all resources, including behind-the-meter (BTM) generation. This annual evaluation could identify a need for additional requirements that would need to be reviewed.
- *SIR224 RPA2.4.* Ensure that there is a strong correlation between the capacity accreditation a market registered resource receives and the amount of capacity that the resource offers into the Integrated Marketplace.
    - SPP should implement a regular review of the differences between accredited and offered market capacity and seek solutions to any discrepancies.
    - SPP should evaluate whether the current must offer provisions properly incentivize the appropriate actions as it relates to offered capacity in the Integrated Marketplace.
- *SIR225 RPA2.5.* Evaluate the transmission planning, transmission service and accreditation process to reflect system conditions experienced in real time. SPP should consider various probable dispatch patterns and transmission system conditions including N-1-1 planning scenarios. (Moved to Tier 2)
- *SIR226 RPA2.6.* Perform seasonal summer and winter LOLE studies. SPP should develop a scope and perform a winter season LOLE study to determine the amount of capacity needed to maintain a reliable PRM at 1 day in 10 years. The following items will be part of the recommendation:
    - Evaluate the difference in data needs based on the summer and winter seasons and ensure data integrity, including use of winter generator testing data.
    - Place additional emphasis on extreme weather event scenarios (heat, cold, flooding) to evaluate results of increased outage levels.
- *SIR227 RPA2.7.* SPP recommends that outages used in the LOLE study be evaluated based on the following recommendations:
    - Evaluate how planned and unplanned outages should be studied in the LOLE study with an understanding that a certain level of planned outages may be allowed from a seasonal perspective.
    - Evaluate if temperature parameters that impact forced outage rates should be included in the LOLE study; determine how to analyze common mode outages

that should be studied for resource adequacy, including the probability of such outages. Common mode examples could include:

- Model gas transportation limitations.
- Model gas line pumping stations that have electrical pumps.
- Temperature extremes, Flooding and drought conditions.
- Loss of facilities due to transmission outages.

- In the extreme weather event LOLE study evaluate the inclusion of common mode assumptions. Common mode examples could include:
  - Model gas transportation limitations.
  - Model gas line pumping stations that have electrical pumps.
  - Temperature extremes, Flooding and drought conditions.
  - Loss of facilities due to transmission outages.
- Investigate policy changes for dealing with whether generation with requested planned outages should continue to be ineligible to be counted towards meeting an LRE's resource adequacy requirement for the entire season.

- *SIR228 RPA2.8.* SPP and its members should evaluate the need for implementation of winterization requirements for the generation fleet. At a minimum, the following recommendations should be evaluated:
  - Evaluate the types of preparation elements included in a winter plan. Determine what additional steps should be taken during a weather event.
  - Evaluate the need for all generators to have a plan in place.
    - Plan must address and prepare for site-specific temperature and accumulation metrics to be defined.
    - Generators must be able to operate at that temperature range for a determined amount of days.
  - Evaluate industry standards including the current Standard Authorization Request (SAR) at NERC and lessons learned.
  - Evaluate how weatherization plans could have benefited performance of all generators, with benefits specified by fuel source type.
  - Continue to request and/or allow resources to come online early with day ahead schedules and reliability commitments with cost recovery in preparation for extreme events.
- *SIR229 RPA2.9.* Evaluate revising the SPP planning and supply adequacy processes to ensure that adequate generation, able to withstand extreme weather, is available and capable of meeting load demands during the summer and winter seasons, forecasting of all energy sources is available and adequate transmission is in place, including on major

seam areas surrounding SPP. This may take the form of an operations reliability focused resource integration study.

- *SIR230 RPA2.10*. Create a complete listing of all utility scale resources within the SPP BA showing utility scale resources not participating in the Integrated Marketplace for usage in energy emergencies.
- *SIR231 RPA2.11.* Evaluate whether any existing BTM and unregistered generation can or should be activated in lieu of firm load curtailment.
- *SIR232 RPA2.12.* Evaluate the current process and procedures implemented in 2020 for potential improvement and further recommend that all demand response used for resource adequacy should be available to SPP at EEA level 2.
- *SIR233 RPA2.13.* Evaluate whether the current 10 MW requirement for market registration of BTM is sufficient or if this should be lowered to ensure SPP has the visibility it needs to ensure capacity needed can be called upon.

ERP. IMPROVE EMERGENCY RESPONSE PROCESS AND PLANNING

EMERGENCY RESPONSE PROCESSES AND PLANNING

Table 4: Summary of recommendations to the board related to emergency response processes and planning

#	TIER	CATEGORY	RECOMMENDATION
ERP 1	2	Assessment	Evaluate alternative means of determining each transmission operator's allocation of load-shed obligations.
ERP 2	2	Action	Implement improvements to load-shed processes to be developed by the Operating Reliability Working Group (ORWG), such as: • Utilize real-time load values when determining load-shed ratio shares. • Train and drill on multiple overlapping load-shed instructions. • Perform a detailed review of models used to determine load-shed ratio shares. • Develop and document procedures and processes to address the timing and responsibility of curtailing exports before and during a load-shed event.
ERP 3	2	Policy	Develop a policy to ensure TOP emergency response and load-shed plans have been reviewed, updated and tested on an annual basis to verify their effectiveness, with attention to critical infrastructure.

LOAD SHED

The load shed process is defined in the SPP BA EOP[1]. Manual load shed, also known as firm load shed in the EOP, is the curtailment of firm load under an energy emergency alert (EEA) level 3 when all other means of supplying internal load have been exhausted, or to maintain area control error (ACE) so as to not jeopardize the reliability of the Bulk Electric System. Per the SPP Operating Criteria and Appendices[2], the Reliability Communications (R-Comm) tool is the primary means of communication for responsible entities to receive, acknowledge, and carry out load shed instructions issued by the SPP BA. SPP real-time staff perform load shed tests regularly. SPP also conducts annual training for SPP operators on energy emergency alerts and load shed for the SPP BA, including the use of the R-Comm tool.

[1] Revision 7.5 (Effective 09/30/2020), https://www.spp.org/spp-documents-filings/?id=34055
[2] Revision 2.2 (Effective 06/17/2019), https://www.spp.org/documents/60100/spp%20operating%20criteria%20and%20appendices%20v2.2.pdf

During the 2021 winter weather event, the SPP BA directed transmission operators to implement their manual load shed plans once on February 15, 2021 and two more times on February 16, 2021.

Load Shed During System Congestion

During load shed on Tuesday, February 16, 2021, there were locations where generation was curtailed at the same time load was being shed on the same side of constraints. Considering that load shed can be considered a very expensive demand response unit, it may not be optimal to dispatch a high cost unit up at the same time a lower cost unit is being dispatched down in the same area. Pro-rata curtailments are reasonable when there is no congestion on the system but could lead to excessive load shedding during times when there is congestion on the system.

Distinguishing Between Firm and Non-Firm Exports

SPP did not distinguish between exports that were firm (associated with a capacity or firm energy transaction) versus non-firm energy during the EEA. NERC Reliability Standard EOP-011-1 Attachment 1 identifies that during an EEA level 1 "Non-firm wholesale energy sales (other than those that are recallable to meet reserve requirements) have been curtailed." During the event SPP treated exports at the level of their transmission service priority only and ignored the firmness of the energy that was associated with the transaction. This resulted in non-firm energy sales not being curtailed, even while firm load within SPP was being curtailed. Curtailment priorities during an EEA should be based upon the firmness of the energy and not the firmness of the transmission service associated with the transaction. SPP needs procedures and processes that clearly identify that curtailment is based upon the transmission service level for transmission curtailments and based upon the level of firmness of the energy for EEAs.

Embedded Entities and Load Shed Procedures

SPP did not have an accurate representation of which embedded entities were contained within various TOP footprints. Additionally, some TOPs did not understand the load shed amount they were given included the total load connected to their transmission footprint and not just their entities load. As a result, some entities may have not been included in the load shed event and other entities may have had incorrect amounts of load shed requested of them.

Load Ratio Share for Load Shed

The load ratio share used to determine each TOP's share of the manual load shed amount is based upon prior year energy use for a season. Some customers were proactive and voluntarily reduced their demand for electricity in response to public appeals or as part of an interruptible load program. The current paradigm does not recognize the contributions to the entire SPP region that these reductions provide. One way to recognize these contributions would be to calculate load ratio shares used for load shed based upon actual loads at the time of the event.

Load Shed Instructions

On February 16, 2021 at 6:44 AM SPP initiated a load shed event for 1350 MWs of BA load. Thirty-three minutes later at 7:17 AM SPP initiated a second load shed event for an additional 1350 MWs of BA load. The result was confusion by several TOPs who were unsure if they had received a second load shed instruction, or a secondary notification of the initial load shed instruction. SPP staff noted that the separate instructions were accompanied by unique R-Comm event IDs. Although a partial load restoration was not necessary, SPP was prepared to use the load shed calculator if the need arose. There is an R-Comm enhancement currently underway that would allow for systematic processing of partial load restoration.

ERP RECOMMENDATIONS

SIR234 ERP1. EVALUATE ALTERNATIVE MEANS TO DETERMINE WHERE LOAD SHED SHOULD OCCUR. (TIER 2)

ERP2. IMPLEMENT IDENTIFIED IMPROVEMENTS TO LOAD SHED PROCESSES. (TIER 2)

- *SIR236 ERP2.1.* Develop and document procedures and processes to address the timing and responsibility to curtail exports based upon the reason for curtailment. For transmission congestion the curtailment is based upon the firmness of the transmission service. For energy emergencies, the curtailment should be based upon the firmness of energy. SPP should ensure that the firmness of transmission service and energy is properly documented and validated for each tag.
    - Curtail all non-firm energy export transactions during an EEA level 1 and do not curtail firm energy exports unless the resource(s) providing the firm energy are not able to meet the export schedule. Curtailments associated with an EEA should not be based upon the transmission service level alone. Curtailments associated with transmission congestion should be based upon the transmission service level.
- *SIR 237 ERP2.2.* Perform a detailed review of the model used for determining load shed shares within the SPP region.
- *SIR238 ERP2.3.* Clearly communicate with each TOP the boundaries used in determining the ratio of load to be shed and other entities load that is included in each TOP's allocation. The TOPs then have the ability to allocate the load shed amongst the entities (SPP BA EOP).
- *SIR239 ERP2.4.* Incorporate multiple overlapping load shed instructions into trainings and drills, placing emphasis on the R-Comm event ID number.
- *SIR240 ERP2.5.* Pursue the R-Comm enhancement for partial load shed restoration.

- *SIR241 ERP2.6.* Evaluate the need for additional coordination with load serving entities as to whether there are any regulatory procedures they must comply with in order to shed load. Determine potential impacts to existing procedures.

- *SIR242 ERP2.7* Investigate utilizing current load values when determining the load ratio share for manual load shed events.

- *DELETED ~~ERP2.7.~~* ~~Determine the appropriate base load value(s) to be used to calculate firm load shed obligations for each responsible entity.~~

    - ~~Ensure procedures allow SPP to gain a better sense about the amounts of firm and non-firm load.~~

    - ~~Evaluate the need to incorporate additional changes to procedures and training, including the consideration of potential shed load in uncertainty studies, etc.~~

SIR243 ERP3. DEVELOP A POLICY TO ENSURE TOP EMERGENCY RESPONSE AND LOAD-SHED PLANS HAV EBEEN REVIEWED, UPDATED AND TESTED ON AN ANNUAL BASIS TO VERIFY THEIR EFFECTIVENESS, WITH ATTENTION TO CRITICAL INFRASTRUCTURE. (TIER 2)

OTCP. IMPROVE OPERATOR TOOLS, COMMUNICATIONS AND PROCESSES

OPERATOR TOOLS, COMMUNICATION AND PROCESS

Table 5: Summary of recommendations to the board related to operator tools, communications and processes

#	TIER	CATEGORY	RECOMMENDATION
OTCP 1	2	Action	Develop or enhance the tools, communications and processes identified by the ORWG and needed to improve SPP and stakeholder response to extreme conditions, such as: • Enhance real-time cascading analysis studies and post results. • Develop tool(s) to increase operator awareness of Out of Merit Energy (OOME) instructions. • Enhance and expand the use of R-Comm. • Create a reliability dashboard to improve situational awareness for operators. • Utilize member-maintained distribution lists for communications purposes. • Develop a process to update operations management during extreme conditions.

CASCADING ANALYSIS

During February 15 and 16, 2021 there were flowgates loaded above 115% of their emergency ratings post-contingent. SPP has processes that instruct staff to perform a cascading analysis for post contingent loading levels above 115%. Although this as a good practice, the results of these analyses are not available for TOPs for review. One risk that is not considered is the possibility that lines loaded above their emergency ratings may sag into other lines they cross. Lines can trip at lower loadings than the relay trip points.

OOME MANAGEMENT

When SPP issues out-of-merit-energy (OOME) instructions, there is not a consistent method to inform SPP real-time operations personnel when conditions have changed which will permit the release of all or part of the OOME instruction. In addition, there were locations where low-cost resources were manually dispatched down at the same time high cost resources were brought online at the same BUS.

CONGESTION MANAGEMENT

There were times when the market was unable to solve congestion due to the violation relaxation limit (VRL) being less than the cost to move resources. This was exacerbated by an increase in the maximum energy price, but when the market doesn't have enough resources to balance load with resources and interchange and resolve congestion, the congestion will remain. As shedding load is just a high cost demand response resource, it may be beneficial in the long run to identify pockets where load reductions would be the least costly to resolve congestion once the congestion has not been corrected for several market iterations. In addition, it may not be readily apparent to TOP operators the Market Clearing Engine (MCE) is not respecting this constraint because the cost to solve the congestion is greater than the (VRL).

R-COMM

The R-Comm tool performed well throughout the event. Communications were timely and the information provided to the TOPs via R-Comm was timelier than other methods of communications. Especially when messages require acknowledgement, there is a high degree of confidence the message will be received. When R-Comm was originally rolled out, there were concerns TOP operators may not pay attention to the messages that were sent over R-Comm alone. This event demonstrates that R-Comm is an effective mechanism for real-time operations communications between SPP and its TOPs. At times the additional blast calls and satellite phone calls served as more of a distraction rather than an enhancement of the communications process. These communications mechanisms can serve as a backup means of communication, but are not needed when R-Comm is functional.

RELIABILITY DASHBOARD

While TOPs have avenues to view some SPP system-wide data, the paths are disjointed and the data available does not provide a complete system overview. Offering TOPs a single tool that provides a complete system overview would help TOPs better understand the state of the SPP region in real-time. Additionally, conservative operations alerts can have many different interpretations, ranging anywhere from business as usual to TOPs canceling and recalling outages. Associating conservative operations alerts with defined alert levels would give more meaning to the conservative operations alerts and help members react to the alerts accordingly.

CONTACT LISTS

The pre-event calls between SPP and the ORWG members provided valuable communications on the situation unfolding. There were others in SPP that could have benefited from this information and SPP could have benefited from others having this information firsthand. However, there was no readily available contact list that SPP could utilize to quickly organize a webex or conference call. Furthermore, it would be advantageous for SPP to develop e-mail lists that utilize distribution lists developed by each operating entity for different types of notifications (weather alerts, resource alerts, conservative operations, maximum generation alerts and energy emergency alerts). SPP needs to identify whether each group may contain

merchant employees or not. This will be determined by the type of information sent to each list. Having the entities maintain internal distribution lists with SPP just sending information to a single list, will place responsibility and control of who receives the messages within the membership. This may result in more up to date distribution lists.

OPERATIONS UPDATES

Prior to the cold weather event SPP's communication and updates to the members was beneficial and helped prepare the members for the event. Once the event started, communication between SPP and the members reduced. Increased communication during these time would help the members' operations staff understand the current situations and what is needed.

PUBLIC APPEAL FOR LOAD REDUCTION

SPP worked with members' corporate communications departments to issue public appeals on Sunday to reduce load on days following. The timing allowed customers to be aware and appeared to significantly reduce load compared to forecast during the highest load periods. NERC Attachment 1 of EOP-011-1 doesn't recommend public appeals to reduce load until a BA reaches an EEA level 2. Issuing public appeals does require some time to make the appeal and for customers to respond. It seems more reasonable to have an appeal issued in advance of the event when possible.

OTCP RECOMMENDATIONS

OTCP1. DEVELOP OR ENHANCE THE IDENTIFIED TOOLS, COMMUNICATIONS AND PROCESSES NEEDED TO IMPROVE SPP AND STAKEHOLDER RESPONSE TO EXTREME CONDITIONS. (TIER 2)

- *SIR245 OTCP1.1.* Post cascading analysis results (with respect to flowgates) to R-Comm or GlobalScape
- *SIR246 OTCP1.2.* Consider other limiters in cascading analysis in addition to relay limits. One method could be to ensure any operating guide may be effectively implemented within ten minutes. Consider asking transmission owners (TOs) to rate their equipment down to 32 degrees.
- *SIR249 OTCP1.3.* Develop automated methods to identify: a) when certain manual dispatches may not be appropriate (dispatching high cost resources up and low cost resources down at electrically equivalent locations), and b) when manual dispatch instructions issued to relieve congestion can be relaxed due to changing system conditions.

- *SIR247 OTCP1.4.* Investigate changes to the market design to identify most cost effective locations for load reductions for use by TOPs when the resource redispatch cannot relieve congestion and meet the load/resource balance.

- *SIR248 OTCP1.5.* Consider adding a state on the R-Comm and table on the SPP contour map to indicate the maximum violation relaxation limit has been met. Something along the lines of "not respected" to notify TOPs the market is not attempting to resolve the constraint.

- *SIR250 OTCP1.6.* Enhance the use of R-Comm for communications with the TOPs by formally adopting R-Comm as the primary form of communication for real-time system-wide operating information. Additional forms of communication (blast calls, email, satellite phone, etc. should remain in place only as backup).

- *SIR251 OTCP1.7.* Consider expanding R-Comm to include Market Participants. The information being shared should be separated to only include the relevant information the Market Participants need and refrain from providing Transmission related information. Another option would be to have a parallel market communications system for reliability communication with all Market Participants.

- *SIR252 OTCP1.8.* Evaluate the use of alert Levels to accompany conservative operations alerts, detailing how each alert Level is defined, and what actions TOPs are expected to take. Resource alerts which are currently separate from conservative operations alerts may be integrated into the newly defined conservative operations alert Levels.

- *SIR253 OTCP1.9.* Evaluate creation of a reliability dashboard to improve situational awareness for the operators and TOP's. The information should include the following in a secure format using Marketplace Portal certificates.

    - Load/Wind Forecast
    - Generation Availability/Reserves
    - Imports/Exports (firm/non-firm)
    - General Status Info
    - ACE
    - Conservative Operations Alert Level

- *SIR254 OTCP1.10.* SPP create and maintain contacts list for operational contacts in the SPP region including TOs, generator owners (GOs), and MPs. SPP can consider switching this to utilizing "member created email distribution lists" that members can maintain

- *SIR255 OTCP1.11.* SPP require operational entities within the SPP region create internal distribution lists for operational communications including alert messages based on SPP defined groups/categories (i.e. separate lists for messages concerning conservative operations, EEA's, resource alerts, etc.).

- *SIR256 OTCP1.12.* Hold scheduled periodic,(e.g., once or twice a day, update calls or WebEx meetings to provide operations management with an overview of the current situation

- *SIR257 OTCP1.13.* Develop training to define rules and guidance for alerts/communication. Define criteria of who will hear what message and when. Goal being to ensure necessary communication is provided to all necessary parties at the right time. Could be FAQ, EOP, etc.

- *SIR258 OTCP1.14.* Add details to the communication plan of the interchange ramp limit being removed.

- *SIR259 OTCP1.15.* Review the process of public appeals and ensure that the SPP BA EOP allows for public appeals prior to EEA level 2 when there is a high confidence that resources will be insufficient to meet demand.

SEAMS. IMPROVE TRANSMISSION IMPORT/EXPORT CAPABILITIES AND SEAMS AGREEMENTS

SEAMS AGREEMENTS

Table 6: Summary of recommendations to the board related to seams agreements

#	TIER	CATEGORY	RECOMMENDATION
SEAMS 1	2	Action	Improve seams agreement provisions with neighboring parties to facilitate adequate emergency assistance and fairly compensate emergency energy.

INTERCHANGE INCENTIVES DURING EEA EVENTS

During the 2021 winter weather event, imports into the SPP Balancing Authority were imperative to maintain reliability. Many of the imports were due to Market Participants reacting to the high prices in SPP while some of the imports were due to the SPP BA purchasing emergency energy. During the event, SPP observed the highest level of imports into the market since the market go-live in March of 2014. SPP reached total imports of over 7,500 MW during the event and reached a total net scheduled interchange of importing more than 6,000 MW. The imports observed in the event did appear to respond to the market prices as the imports increase when locational marginal prices (LMPs) increase and the imports decreased when the LMPs decrease, but there was obviously a lag between the price increase and the import response due to the nature of scheduling the imports. This lag also led to instances where the amount of import response all at once reduced the LMP, which led to a response of reduced imports when it may have been desirable to maintain a higher level of imports.

TRANSMISSION IMPORT AND EXPORT CAPABILITIES

The event highlighted the importance of a robust transmission system and SPP relied heavily upon the transfer capabilities with its neighbors to mitigate the issued experienced during the event. Although SPP set records for importing into the SPP BA, significant congestion was experienced. A balanced approach to ensure that SPP's transfer capability to both receive and provide assistance in extreme weather events is considered in both the planning and operational areas should be considered a top priority.

SEAMS AGREEMENTS

The SPP market relies on price signals to create an incentive for Market Participants to submit import interchange transactions when energy supply becomes limited. However, there may be situations where these commercial import interchange transactions are insufficient for the SPP BA to maintain adequate operating reserves and SPP must initiate an EEA in accordance with

NERC Reliability Standards. As of the date of the 2021 winter weather event SPP has two agreements; 1) Attachment 3 of the MISO-SPP Joint Operating Agreement (MISO-SPP JOA[3]) and 2) SaskPower-SPP Joint Operating Agreement (SPC-SPP JOA[4]) and companion SaskPower, NorthPoint Energy, and SPP Emergency Energy Pricing and Settlement Agreement; which provide the rates, terms, and conditions for the exchange of emergency energy between SPP and those adjacent BAs.

Both agreements require that the requesting entity be in an EEA level 2 or higher, as well as require that the emergency energy be formally requested and that the amount (MWs) and duration be coordinated. As specified in the agreements, these emergency energy transactions are intended to continue only until they can be replaced by normal commercial transactions. The rates and charges associated with these emergency energy transactions include a transmission charge and an energy portion. The transmission charges applied include the ancillary services and transmission costs (i.e. non-firm point-to-point transmission service rate) under the delivering party's tariff. The energy portion is determined as follows:

- In the case of SPP as the delivering party, the cost of the energy portion shall be the greater of 150% of any applicable LMP at the point(s) of delivery to provide the emergency energy, or $100/MWHr.
- In the case of MISO as the delivering party, the cost of the energy portion shall be the greater of 150% of the LMP at the point(s) of exit at the bus or buses at the border of the delivering party's market, or $100/MWHr.
- In the case of SaskPower as the delivering party, the cost of the energy portion shall be the greater of 20 Mmbtu/MWh x Henry Hub Natural Gas Spot Price ($/Mmbtu); or $100/MWHr.

The mechanism for allocating costs and revenues associated with emergency energy in accordance with these agreements to Market Participants is revenue neutrality uplift (RNU)[5].

During the 2021 winter weather event, SPP did request and receive 100 MW of emergency energy from MISO in accordance with the provisions of Attachment 3 to the MISO-SPP JOA for a 6-hour period.

[3] Link to MISO-SPP JOA - https://www.spp.org/spp-documents-filings/?id=18418
[4] Link to SPC-SPP JOA - https://www.spp.org/spp-documents-filings/?id=55193
[5] SPP Tariff Attachment AE Section 8.8(1)(a)(iv)

SEAMS RECOMMENDATIONS

SEAMS1. IMPROVE SEAMS AGREEMENT PROVISIONS WITH NEIGHBORING PARTIES TO FACILITATE ADEQUATE EMERGENCY ASSISTANCE AND FAIRLY COMPENSATE EMERGENCY ENERGY. (TIER 2)

- *SIR261 SEAMS1.1.* Evaluate the current pricing structure at the interfaces during EEA events to determine if the prices give the Market Participants the proper incentives to import and maintain those imports.

- *SIR262 SEAMS1.2.* Evaluate whether the current structure appropriately compensates the Market Participants for imports when the LMPs reduce due to the influx of imports.

- *SIR263 SEAMS1.3.* Research possible coordination with other regions to ensure energy is delivered where needed and compensated appropriately without artificially inflating prices due to interconnection wide competition.

- DELETED ~~SEAMS1.4. Continue to focus on planning projects that allow for more efficient use of the transmission system, looking for opportunities to increase import and export capability into the SPP system when possible.~~

- DELETED ~~SEAMS1.5. Establish a renewed emphasis on SPP/MISO interregional transmission projects.~~

- DELETED ~~SEAMS1.6. Continue to require imports transactions to be firm in order to be included in the LOLE study.~~

- *SIR264 SEAMS1.7.* Review current emergency energy agreements and ensure they are consistent and effective.

- DELETED ~~SEAMS1.8. Coordinate additional emergency energy agreements with other neighboring BAs to increase the ability to procure emergency energy when needed.~~

- *SIR265 SEAMS1.9.* Consider whether the rates and charges (Ex: greater of $100 or 150% of LMP) are appropriate or should be renegotiated.

- *SIR266 SEAMS1.10.* Provide a detailed report on how much interchange was due to emergency energy procurement and the uplifted cost of that emergency energy.

MKT. MARKET DESIGN IMPROVEMENTS

MARKET DESIGN

Table 7: Summary of recommendations to the board related to market design

#	TIER	CATEGORY	RECOMMENDATION
MKT 1	2	Policy	Develop and improve policies to ensure price formation and incentives reflect system conditions.
MKT 2	2	Action	Develop and implement market design and market-related enhancements identified by the Market Working Group to improve operational effectiveness and ensure governing language provides needed flexibility and clarity, such as: • Improve the Dispatch Target Adjustment Process. • Enhance the Multiday Reliability Assessment Process.
MKT 3	2	Policy	Develop policies to ensure financial outcomes during emergency conditions are commensurate with the benefits provided.

PRICING DURING EEA EVENTS

PRICE RESPONSIVE LOAD AND PRICING DURING LOAD SHED EVENTS

During the 2021 winter weather event SPP was forced to direct members to shed load in order to maintain reliability and prevent uncontrolled outages. These load shed events occurred on February 15 and February 16, 2021. During these load shed events SPP observed a few intervals where LMPs dropped well below $100. These lower LMPs may have sent the wrong signal to the market during a time when energy was needed so the load could be restored. The price formation and incentives for continued energy delivery may be improved during these times by modifying the pricing structure during load shed events to continue to reflect prices associated with serving the desired amount of load and not the reduced amount of load due to the load shed. Incentives for price responsive load in SPP's market may also improve the price formation during these times by allow the market to determine load reduction based on offers and congestion.

VIOLATION RELAXATION LIMITS AND DEMAND CURVE PRICING DURING EMERGENCY CONDITIONS

During the 2021 winter weather event SPP observed instances where transmission constraint violations were occurring due to energy offer prices being far above the VRL price. Energy prices offered above the highest VRL price can overpower the cost to re-dispatch around transmission constraint which leads to these violations. The current VRL prices were set based on analysis

using the FERC approved $1,000 energy offer cap. However, during the 2021 winter weather event or other emergency conditions when energy offers are greater than $1,000 these VRL prices may not be appropriate.

SPP also observed violations on the spinning reserve requirement and resource ramp rate constraints. Spinning reserve and resource ramp rates are currently priced as VRLs. These VRL prices may not provide transparent prices during events such as the 2021 winter weather event. SPP may desire to change these two requirements to be demand curves instead of VRLs, but this also means SPP must determine the appropriate price for these demand curves.

APPLICATION OF EMERGENCY LIMITS

During the 2021 winter weather event, system conditions dictated that SPP release maximum emergency capacity operating limits in accordance with the prescribed language in both the Integrated Marketplace Protocols and Attachment AE of the SPP Tariff. This release of maximum emergency capacity operating limits allowed for DAMKT dispatch values up to these limits for a number of resources, including some VERs. Additionally, while the DAMKT used emergency capacity operating limits as prescribed by the governing documents, in real-time, emergency capacity operating limits were not used due to operational concerns. This raises the question as to whether or not the application of maximum emergency capacity operating limits is appropriate and provides the value SPP and the membership envisioned during the design of the Integrated Marketplace.

DAY-AHEAD MARKET AND MARKET-TO-MARKET

One purpose of the DAMKT is to give generators and LSEs a means for scheduling their activities sufficiently prior to their operations. This is typically based on a forecast of their needs and consistent with their business strategies. Although SPP committed many resources for reliability reasons, rather than through the usual DAMKT process, the DAMKT continued to give reasonably accurate predictions of the operating day. The exceptions were February 13 and 14, 2021 which SPP repriced after-the-fact.

While the DAMKT focuses on looking ahead and the market-to-market process focuses on real-time, they are both traditionally thought of as tools to further enhance the economic benefits of the Integrated Marketplace and not for their have proven reliability benefits. During the 2021 winter weather event, these benefits were much more evident. By committing resources through the DAMKT process, it reduces the dependency of capacity generation being required to be committed through the reliability unit commitment processes. During the event, this was critical, as it was even more vital to the overall capacity needs to the SPP footprint to ensure all available generation could be utilized appropriately.

Similarly, the market-to-market process ability to utilize the combined generation fleet of both SPP and MISO to mitigate constraints further displayed its reliability benefits. The process allowed for a more systematic response than the alternative methods such as transmission loading relief (TLR). It also provided a mechanism for increased real-time communication on

how mitigation of internal RTO constraints with internal generation would impact the neighboring RTO's constraints.

Most stakeholder discussions about the DAMKT focused on specific issues such as emergency conditions, scarcity, and price formation. Those recommendations are included in the appropriate sections of this report.

MULTI-DAY RELIABILITY ASSESSMENT

SPP's Integrated Marketplace design consists of numerous unit commitment processes beginning with the multi-day reliability assessment (MDRA), continuing with the DAMKT and concluding with the day-ahead, intra-day and short-term reliability unit commitments (RUC). The purpose of the MDRA is to evaluate the reliability-based need to issue instructions to start to resources that cannot be committed in the day-ahead RUC because of their long lead time as well as committing resources as part of conservative operations, as outlined in the SPP BA EOP.

As part of conservative operations, SPP issued resource commitments of various lead times well in advance of the DAMKT in order to give early notice that the resources would be needed and to allow more time to procure the appropriate amounts of fuel needed for the duration of the event. Although similar commitments have been made as part of conservative operations in the past, the scale during this event was unprecedented and has allowed SPP to assess the processes, procedures, and governing language associated with the MDRA process.

IMPROVE DISTPATCH TARGET ADJUSTMENT PROCESS

During the 2021 winter weather event, the SPP BA decided to turn on an operational tool that is downstream from the Real-Time Balancing Market (RTBM) clearing called Dispatch Target Adjustment (DTA). This tool lives in the emergency management system (EMS) application RTGEN. The DTA tool is typically used by SPP operations to balance the SPP region in times when the MCE is not functioning properly or not working at all. During the 2021 winter weather event, the SPP BA decided to use the tool to ensure its ability to balance the region and keep the ACE in check due to insufficiencies in cleared operating reserves from the RTBM and due to uncertainty around the timing of curtailed tags from MISO. Notably, the RTBM cases continued to solve and approve, publishing new dispatches and LMP every 5 minutes. DTA takes the last solved and approved RTBM and adjusts the resulting setpoint as needed to chase the load using the marginal cost calculated in that RTBM. While the setpoint adjustments were generally in merit and updated as RTBM cases approved, there were many instances where resources were positioned out of merit and financially harmed.

FINANCIAL REVIEW

The 2021 winter weather event resulted in unprecedented charges and credits in SPP's Integrated Marketplace. The MWG will continue to review the financial results of the 2021 winter weather event focusing on ensuring that the financial credits awarded during the winter weather event are commensurate with the benefits provided. Specific attention will be paid to virtuals/imports/exports as these instruments are not formally addressed in FERC Order 831.

MKT RECOMMENDATIONS

MKT1. DEVELOP AND IMPROVE POLICIES TO ENSURE PRICE FORMATION AND INCENTIVES REFLECT SYSTEM CONDITIONS. (TIER 2)

- *SIR268 MKT1.1.* Investigate enhancements to the market to incentivize price sensitive demand in real-time (possible redesign of demand response participation models).
- *SIR269 MKT1.2.* Investigate coupling price formation & EEA level together via price administration (Ex: value of lost load as a price floor during EEA level 3 or load shed).
- *SIR270 MKT1.3.* Determine if the spinning reserve and resource ramp rate constraints should be modeled as demand curves instead of VRLs.
- *SIR271 MKT1.4.* Evaluate the operating constraint VRL prices and construct in relation to the 2021 winter weather event. Ensuring the VRLs both adhere to price formation tenets as well as allow for the MCE to provide generation re-dispatch for relief of congested operating constraints should be the focus of this evaluation.
- *SIR272 MKT1.5.* Evaluate the current value provided by using max emergency capacity operating limits for each resource type (if any) and if this should be factored into all studies, some, or none.
- *SIR273 MKT1.6.* Evaluate the validity of max emergency capacity operating limits for VERs during DAMKT emergency conditions.
- *SIR274 MKT1.7.* Evaluate whether all the four sets of limits that SPP currently employs (regulation, economic, normal, emergency) are needed/provide value.
- *SIR275 MKT1.8.* Evaluate whether the addition of turn-around ramp rate factors in DAMKT could provide additional value.
- *SIR276 MKT1.9.* Ensure the Integrated Marketplace Protocols/Tariff clearly describe limit applications during emergency conditions.
- *SIR277 MKT1.10.* Determine whether there is a need for additional training surrounding limit application in the market systems.

MKT2. DEVELOP AND IMPLEMENT IDENTIFIED MARKET DESIGN AND MARKET RELATED ENHANCEMENTS TO IMPROVE OPERATIONAL EFFECTIVENESS AND ENSURE GOVERNING LANGUAGE PROVIDES THE NEEDED FLEXIBILITY AND CLARITY. (TIER 2)

- *SIR279 MKT2.1.* Continue to look for possible improvements to both the DAMKT (more generation committed within the market and not through RUC is better) and market-to-market (utilizes the combined generation from both the SPP & MISO fleet) processes.

- *SIR280 MKT2.2.* Review curtailment of fixed demand bids as it relates to emergency conditions in the DAMKT.

- *SIR281 MKT2.3.* Clarify governing language describing MDRA process and associated financial settlement.

- *SIR282 MKT2.4.* Enhance MDRA to include the economic evaluation of resources that cannot be committed in the day-ahead RUC because of their long lead time.

- *SIR283 MKT2.5.* Evaluate revising the MDRA design to allow Market Participants to treat resources committed from MDRA in a similar manner to the treatment afforded to Multi-Day Minimum Run Time resources as outlined in RR382 (multi-day minimum run time and clarifications).

- *SIR284 MKT2.6.* Enhance the MDRA process to ensure the proper incentives exist to ensure supply is available.

- *SIR285 MKT2.7.* Enhance the MDRA process to include additional information related to resource availability such as fuel delivery infrastructure, on-site fuel storage, and the location of critical loads.

- *SIR286 MKT2.8.* Enhance commitment notifications to raise Market Participant awareness and simplify commitment instructions.

- *SIR287 MKT2.9.* Educate Market Participants on the information already available to them with regards to MDRA commitment instructions.

- *SIR288 MKT2.10.* Enhance conservative operations notifications to include guidance related to fuel management.

- *SIR289 MKT2.11.* Enhance multi-day forecast to provide better information to Market Participants.

- *SIR290 MKT2.12.* Enhanced cost recovery mechanisms for committed units, such as:

    - Consider changes to the make-whole payment calculation to allow for cost recovery when abnormal conditions require a resource to start ahead of the

scheduled time in order to ensure the resource will be online for the committed period.

- Consider cost recovery/incentives for resources to provide greater flexibility to the grid.

- Research ways for Market Participants to submit parameters for units susceptible to adverse conditions (potentially tie parameter submission to resource design specifications).

- *SIR291 MKT2.13.* Create a revision request (RR) to describe DTA's purpose, use, and relevant settlements impacts

- *SIR292 MKT2.14.* Create and/or revise operational processes & procedures to clearly communicate when DTA is in-use

- *SIR293 MKT2.15.* Reassess DTA to ensure that there are no unintended and local consequences resulting from the market-wide set point instruction adjustments (specifically when those adjustments are out of merit)

MKT3. DEVELOP POLICIES TO ENSURE FINANCIAL OUTCOMES DURING EMERGENCY CONDITIONS ARE COMMENSURATE WITH THE BENEFITS PROVIDED. (TIER 2)

- *SIR295 MKT3.1.* Review the financial results of the 2021 winter weather event focusing on ensuring that the financial credits awarded during the 2021 winter weather event are commensurate with the benefits provided. Specific attention will be paid to virtuals/imports/exports as these instruments are not formally addressed in FERC Order 831.

TXP. TRANSMISSION PLANNING IMPROVEMENTS

TRANSMISSION PLANNING

Table 8: Summary of recommendations to the board related to transmission planning

#	TIER	CATEGORY	RECOMMENDATION
TXP 1	2	Policy	Develop policies that facilitate transmission expansion needed to improve SPP's ability to more effectively utilize the transmission system during severe events.
TXP 2	3	Policy	Develop transmission planning policies that improve input data, assumptions or analysis techniques needed to better account for severe events.

2021 WINTER WEATHER EVENT OPERATIONAL PATH REVIEW: TRANSMISSION

As a part of SPP's comprehensive review of the 2021 winter weather event, the TWG focused on identifying potential improvements to SPP's planning process to ensure SPP's transmission system and transmission planning processes are well equipped to handle potential operational events in the future.

OBJECTIVE

The TWG supports the effort to identify improvements to SPP's planning processes given the magnitude and disruption caused by the 2021 winter weather event. While the TWG's assessment of the event has led them to the conclusion that it was mainly driven by generation unavailability, the group is suggesting several acknowledgments and recommendations. These acknowledgments and recommendations include highlighting existing SPP planning processes, new high priority recommendations, and additional topics for consideration.

The TWG developed these recommendations based on their review of the 2021 winter weather event and have not yet taken into account the potential cost or impacts to resources, processes, and schedules. While the TWG acknowledges the ongoing prioritization and mitigation efforts of the SPP planning processes, the group felt the best response to the review was to develop the recommendations before any impact assessment or prioritization with other efforts.

TWG TOP PRIORITY RECOMMENDATIONS:

TXP1. DEVELOP POLICIES THAT FACILITATE TRANSMISSION EXPANSION NEEDED TO IMPROVE SPP'S ABILITY TO MORE EFFECTIVELY UTILIZE THE TRANSMISSION SYSTEM DURING SEVERE EVENTS. (TIER 2)

- *SIR297 TXP1.1.* Continue focus on improving seams/interregional transmission planning processes and coordination
- *SIR298 TXP1.2.* Develop process changes within the ITP that allow for rotating analysis of potential operational events
- *SIR299 TXP1.3.* Develop a process to allow for contingency analysis associated with the rotating event scenario recommendation

TXP2. DEVELOP TRANSMISSION PLANNING POLICIES THAT IMPROVE INPUT DATA, ASSUMPTIONS, OR ANALYSIS TECHNIQUES TO BETTER ACCOUNT FOR SEVERE EVENTS. (TIER 3)

- *SIR301 TXP2.1* Utilize the 2021 winter weather event for use in the next NERC MOD-033 power flow validation

DATA AND INFORMATION

The TWG utilized several sets of data and information as a part of their review of the 2021 winter weather event.

BINDING CONSTRAINTS

The TWG was briefed on primary contributors to transmission congestion during the 2021 winter weather event. This information highlighted different areas within the SPP transmission system where severe loadings were experienced.

Region	Flow Direction	Contributing Factors	Primary Reliability Concerns	Mitigating Actions	# of Severe Constraints
Western Kansas	NW → SE (into SPP)	• Heavy imports into SPP • 345kV line outage	• Real-time overloads • Potential loss of load pocket	• OOME • Post-contingent load shed plan • Pre-contingent load shed	17
Eastern Nebraska Eastern Kansas	NE → SW (into SPP)	Heavy imports into SPP	Potential for widespread issues for the loss of 345 kV path	• TLR • OOME	18
Western Arkansas	E → W (into SPP)	• Heavy imports into SPP • 500/161 kV transformer outage	• Potential voltage collapse in northern Arkansas • Real-time overload on 500 kV line	• TLR • OOME	6
Eastern Texas	E → W (into SPP and ERCOT)	• Heavy imports into SPP • Area generation trip	• High post-contingent loading in SPP • MISO concerns of cascading in northwestern Louisiana	• TLR • DC tie cuts	4

Table 1: Severe Loading Summary

OPERATIONS VS. PLANNING GENERATION AND LOAD COMPARISONS

The TWG reviewed a comparison of a 2021 Integrated Transmission Planning (ITP) base reliability winter peak model with an operational case from a 9:00 a.m. (CDT) snapshot on February 15, 2021. The model used was projected to be one year out from the actual event with 50/50 non-coincident load values. These planning models typically include the latest generation additions and retirements from 2019-2020. The conclusion shown in Figure 1 identified operational generation during the snapshot was 18.6% lower than the planning model generation and operational load from the snapshot was 6.7% lower than the planning model load forecast. A key difference in the generation can be attributed to large amount of firm generation dispatched in the base reliability model being unavailable during the 2021 winter weather event. Some of the load differences can be attributed to a comparison of coincident peak load operationally to a non-coincident peak in the base reliability model. A higher non-coincident peak should be expected with respect to a coincident peak, which is seen in this comparison.

Figure 2: Total SPP Generation and Load

ADDITIONAL OPERATIONAL DATA

The TWG utilized several sets of operational data in their review of the 2021 winter weather event (*e.g.,* supply mix, generation outages, and net energy imports). One of the most relevant pieces of data in the TWG review of transmission processes was related to the magnitude of energy SPP was importing from neighboring systems. At times during the winter storm event, SPP was importing significant amounts of energy to support a lack of capacity within the region.

EXISTING PROCESSES

As a part of the TWG's comprehensive review of the 2021 winter weather event and discussions on the necessary improvements to the planning process, the group reviewed current processes to assess what SPP was already doing to plan for potential operational events. Below are the existing processes which SPP utilizes to plan the transmission system for such events.

TPL-001-4 EXTREME EVENT ANALYSIS

Consistent with NERC standards, SPP annually studies extreme events through the TPL-001-4 process. This evaluation studies the impact of extreme events on the SPP transmission system by identifying potential steady state and stability violations. While this analysis is not typically performed on winter peaking models, it still provides useful analysis of extreme events on a broader spectrum than a typical N-1 analysis.

MOPC ACTION ITEM 302 - CONTINGENCY ANALYSIS

In October of 2019, the Markets and Operations Policy Committee (MOPC) took an action item for the TWG and Economic Studies Working Group (ESWG) to develop approaches that address winter peaking and cold-weather driven reliability issues for incorporation in SPP's normal planning processes.

SPP staff and stakeholders agreed on an approach to address this action item through contingency analysis within the ITP process. Stakeholders were requested to submit additional more extreme contingencies related to winter weather driven issues. This analysis is being done for the first time as a part of the 2021 ITP assessment and is currently ongoing. While this evaluation is being done for informational purposes only, it is an avenue that will allow for greater insight into the potential violations caused by winter weather.

While the TWG sees the benefit in continuing to better incorporate winter weather driven reliability issues into the planning process, this 2021 winter weather event review has brought to light the need to reassess the contingency analysis approach used for this evaluation. This will be an action pursued by the TWG outside of the scope of this review.

ITP FUTURES AND SENSITIVITY ANALYSIS

During scope development for SPP's ITP planning process, staff and stakeholders collaborate to develop a list of drivers, as well as the probability of each driver's occurrence, to develop different futures or scenarios for analysis in the study.[6] These futures represent expectations of future trends and their potential impact to the energy industry and transmission planning efforts. Additionally, scope development includes the selection of different sensitivities to measure the flexibility and resiliency of the final consolidated portfolio in each future under different uncertainties (*e.g.,* high/low wind, high/low demand, extreme events).[7]

ITP BENCHMARKING[8]

Model benchmarking in the ITP planning process is compared to the previous ITP modeling outputs and historical SPP real-time data to provide the most value and ensure the accuracy of the ITP models. Industry information is also utilized during benchmarking, as well, to further support the model data (*e.g.,* U.S. Energy Information Administration (EIA) data). This link between planning and operations can help SPP to better plan for potential operational events.

[6] See ITP Manual, section 2.2.1.1.
[7] See ITP Manual, section 7.2.
[8] See ITP Manual, section 3.

ITP TARGET AREA ANALYSIS[9]

Models are developed for years two, five and 10 for SPP's ITP planning process to assess future system needs, as well as to filter and rank the congested constraints of each future and study year to target a list of economic needs for the ITP study. The constraint list is condensed by identifying the target areas (top areas of known or forecasted congestion) to more efficiently focus the combined efforts of SPP and stakeholders to identify the most valuable solutions. This process gives SPP the ability to perform additional analysis outside the scope of typical ITP analysis. This additional analysis could be used to study potential operational events.

ITP PERSISTENT OPERATIONAL NEEDS[10]

While SPP's ITP process is primarily a forward looking process, the ITP does allow for the evaluation of persistent operational needs. This process utilizes historical operational data to identify reoccurring real-time needs along the transmission system that may be missed by traditional planning models. This ability to identify and address operational needs within the ITP increases system reliability and SPP's ability to respond to operational events.

WHEELING THROUGH AND OUT REVENUES BENEFIT METRIC[11]

SPP's ITP process utilizes a suite of benefit metrics that are meant to measure the potential benefit gained by the addition of transmission. One of those metrics is identifying increased wheeling through and out revenues. This metric is focused on a transmission project or portfolios ability to increase available transfer capability (ATC) between the SPP transmission system and a neighboring region. Any increased interregional transmission capacity that increases through and out transactions, also increases SPP's wheeling revenues. This benefit metric allows SPP the ability to measure those increases in revenues and value projects differently based on their ability to import and export.

RISK-BASED PLANNING

Greater incorporation of risk-based planning approaches into SPP's normal planning process is an ongoing effort and goal of SPP's transmission planning department. Many of the recommendations and considerations for changes to SPP's transmission planning processes as a response to the review of the 2021 winter weather event are considered risk-based planning activities. Further incorporation of these approaches as SPP's planning processes mature will only increase our ability to be prepared for future operational events.

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[9] See ITP Manual, section 4.1.2. Also, the recent 2021 ITP needs assessment posting on May 10, 2021, references the target area scope documents and provides the location of these documents on GlobalScape.
[10] See ITP Manual, section 4.4.
[11] See ITP Manual, section 7.1.

RECOMMENDATIONS

The recommendations in this section of top priorities are where the TWG suggests the most time and effort should be spent as an initial response to the review of SPP's transmission planning process, given the 2021 winter weather event.

DEVELOP PROCESS CHANGES WITHIN THE ITP THAT ALLOW FOR ROTATING ANALYSIS OF POTENTIAL OPERATIONAL EVENTS

As discussed in the section above, SPP has several existing processes that provide SPP the ability to plan the transmission system for potential operational events. However, given the review of this 2021 winter weather event and the TWG's knowledge of other previous operational events the group recommends SPP staff and stakeholders work together to develop a process within the ITP that allows for the rotating scenario analysis of these events.

The TWG acknowledges these recommendations will need to be further developed and implemented through the SPP stakeholder process through coordination with the ESWG, MOPC, and other applicable SPP working groups. The suggested process, requirements, and applications below are meant to guide future discussions and refinement of this recommendation.

Suggested Process, Requirements, and Application

- Flexible process within the existing ITP or the new SPP Strategic and Creative Re-engineering of Integrated Planning Team (SCRIPT) planning process that allows for annual evaluation if necessary
    - Decided annually by staff and stakeholders
- Flexible scoping process
    - Not limited to winter weather conditions, including, but not limited to:
        - Cold Snap
        - Drought
        - Heat wave
        - Limited Fuel (*e.g.*, wind, gas)
    - Potential event scope developed each time the evaluation initiated
    - Ability to limit to specific portions of the footprint
- Model Development
    - Revise the ITP Manual, section 2.2 (Market Economic Model Overview) to allow for additional modeling of potential operational event for both Market Powerflow Model development and benefit evaluation later in the process
    - Revise the ITP Manual, section 2.3 (Market Powerflow Model Overview) to allow for flexibility in selecting the economic hour to model

        - Remove references on specific sensitivity model requirements
        - Set a maximum number of models that can be requested
        - Provides the ability for these models to be used in TPL analysis
- Evaluation/Project Selection
    - Violations on potential operational event models will be evaluated and posted
        - These violations will not solely drive the need for transmission investment, but may support an incremental increase in transmission investment
        - Violations identified within the potential operational event models will be compared with violations identified within the existing ITP process to add to the project selection process and to right-size, accelerate, and/or develop notification to construct (NTC) recommendations for potential projects
    - Prospective ITP portfolios can be tested for resiliency against the violations identified in the potential event models
- The process should provide SPP the ability to study a wide array of potential operational events and the potential transmission system needs associated with each
    - No requirement to build additional NTCs to address these issues

DEVELOP A PROCESS TO ALLOW FOR CONTINGENCY ANALYSIS ASSOCIATED WITH THE ROTATING EVENT SCENARIO RECOMMENDATION

The recommendation above for rotating scenario analysis of potential operational events will give SPP the ability to study operational event scenarios on a regional or targeted geographical basis. The TWG also recommends that a process be developed to allow for member submitted contingencies to be evaluated in coordination with the scenario analysis. This additional portion of the analysis will provide a mechanism to study more known local issues (*e.g.,* load pockets). This recommendation would likely result in revisions to sections 4.2.1 and 4.2.2 of the ITP Manual.

<u>Suggested Process, Requirements, and Application</u>

- Encourage Stakeholder Participation
    - Provide education and notification to stakeholders on the process
    - Regular updates on when submissions are due
- Strive for Quality Submissions and Evaluation
    - Request submitted contingencies include dispatching generation to make up for plants lost in contingency

    - Request solve methodologies including adjustments to make up for lost generation without using the system swing

CONTINUE FOCUS ON IMPROVING SEAMS/INTERREGIONAL TRANSMISSION PLANNING PROCESSES AND COORDINATION

The TWG's review of the 2021 winter weather event highlighted the importance of SPP's ability to assist and receive assistance during energy emergencies and other extreme events. While the TWG wants to build a robust regional planning processes to evaluate potential operational events without having to be reliant on assistance from neighboring systems, the group also recognizes the benefits of an interconnected system. Given these points the TWG recommends the continuation of ongoing SPP efforts to enhance seams and interregional transmission planning processes and coordination.

The TWG was updated on the ongoing efforts of the SCRIPT specifically in the area of transfers. The TWG recognizes that the SCRIPT ongoing efforts have the potential to address and improve joint planning processes. The TWG will continue to follow the SCRIPT efforts to ensure progress is being made in improving joint planning process as a response to the 2021 winter weather event review. In addition to the SCRIPT, the TWG also supports placing focus on the continuous improvement of other seams and interregional transmission planning processes.

- Explore improvements to SPP's existing seams and interregional planning processes
    - Midcontinent Independent System Operator (MISO)
    - Associated Electric Cooperative, Inc. (AECI)
    - Saskatchewan Power Corporation (SASK)
- SPP-MISO Joint Targeted Interconnection Queue (JTIQ) Study
- SPP-MISO Interregional Planning Stakeholder Advisory Committee (IPSAC)
- SPP-AECI IPSAC

The TWG also recommends that SPP explore benefits associated with the development of additional joint planning processes with ERCOT and the Western Interconnect.

UTILIZE THE 2021 WINTER WEATHER EVENT FOR USE IN THE NEXT NERC MOD-033 POWERFLOW VALIDATION

NERC MOD-033-1 requires a powerflow and dynamic validation every two years. The next MOD-033-1 powerflow validation starts July 2021 and completes July 2023. This effort recommends comparing the planning model results based on pre-event state estimator model representation, including:

- Generation comparisons by availability, fuel type, and operating amounts
- Load comparisons on zonal level
- Outage comparison between models

- Generation and Load comparison by ratio
- Identify unacceptable results based on SPP MOD-033-1 acceptable criteria thresholds

The TWG recommends utilizing the 2021 winter weather event for evaluation in the next MOD-033 powerflow validation.

ADDITIONAL FOCUS AREAS

The topics in this section are where the TWG would like to spend more time considering the scope, benefits, and drawbacks of these potential recommendations. This section also includes considerations that were displaced by higher priority recommendations.

All the topics in this section are considered a low priority and at this time do not warrant a specific timeline.

EVALUATE THE SPP TRANSMISSION SYSTEM'S IMPORT/EXPORT CAPABILITY

As noted in previous sections, SPP's ability to import power played a major role in the ability to respond to this 2021 winter weather event. The TWG discussed the need to perform an evaluation of the SPP transmission system's import/export limits during a winter peak. This would allow for a comparison of the import amounts associated with the 2021 winter weather event and what our forward looking planning models show the system has the ability to provide. In lieu of recommending this analysis, the TWG will review the current analysis that is performed as a part of the SPP TPL-001-4 assessment to see if it meets the needs of this system import/export capability assessment.

SPP saw significant imports from neighboring regions during the winter event, which at times reached 6 GW. However, the majority of these imports were non-firm energy and emergency assistance.

At this time the SAWG does not feel that the non-firm imports can be relied on for the whole season, therefore recommends continuing with requiring imports transactions to be firm to be included in the LOLE study.

REASSESS TRANSMISSION PLANNING BENEFIT METRICS RELATED TO IMPORT/EXPORT CAPABILITY

Adjusted production cost (APC) and the wheeling through and out revenues benefit metrics are existing metrics within SPP's planning processes used to value potential transmission projects ability to import and export. The TWG discussed the need to re-evaluate these metrics and considered the need for development of additional metrics to more appropriately place value on a transmission project's ability to import and export. This was considered based on the idea that additional import/export capability allows for SPP to increase its ability to assist and receive assistance during energy emergencies and other extreme events. Due to ongoing work of the SCRIPT and other joint planning efforts via the Seams Advisory Group (SAG), the TWG did not

feel the need to make this a top priority but would consider it as a potential improvement once those ongoing efforts are further down the road.

EXPLORE THE BENEFITS OF TRANSMISSION ALTERNATIVES

SPP's planning processes are primarily set up to identify potential system violations and assess the ability to address those potential violations with transmission additions. However SPP's ITP process requires the evaluation of transmission alternatives (*e.g.,* generation options, demand response programs, "smart grid" technologies, and energy efficiency programs). Given the 2021 winter weather event being reviewed and the potential for other extreme events to occur are likely to have a low probability of occurrence, the TWG suggests that SPP continue to consider transmission alternatives when assessing the best way to plan the transmission system to better withstand future operational events.

EXPAND PERSISTENT OPERATIONAL ISSUES

As discussed in the explanation of existing processes that help SPP plan the transmission system for potential operational events, the persistent operational issues process allows for the evaluation of persistent operational needs within the ITP. The TWG suggest SPP should consider re-evaluating the criteria requirements that must be met for an issue to make its way into the ITP process. Expanding or changing this criteria could potentially allow for additional operational needs to be solved through the ITP process. Specifically, the process could be expanded to capture additional key constraints that are critical to previously experienced operational events.

CONSIDER LOWER PROBABILITY/HIGHER RISK LOAD FORECAST IN PLANNING

Generally, the reliability powerflow models utilized within SPP's planning processes are based on 50/50 load projections. A 50/50 load forecast relates to a forecasted load amount having an equal probability of being either higher or lower than the amount forecasted. The forecasted load value is at the 50th percentile of a normal or similarly shaped distribution curve and is typically discussed in terms of exceedance such that there is a 50% probability that the load forecast will be exceeded due to abnormal weather. The TWG considered if SPP should collect and evaluate assessments on lower probability but higher risk load forecast. Given the 2021 winter weather event this was specifically discussed in reference to the potential of a winter peak sensitivity model. This was based on the idea that a lower probability/higher risk forecast (*e.g.*, 90/10 load) could provide an opportunity to analyze extreme winter system conditions. While this is still a potential path forward or a portion of other evaluations, the TWG preferred the additional evaluations described in the top priorities section of the paper.

WINTER SEASON RESOURCE ADEQUACY REQUIREMENT

SPP recommends a LOLE study for the winter season be performed. Based on the results of the winter season LOLE study, policy discussion will take place on continuing with the winter season obligation versus implementing requirements similar to the summer season.